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Artificial Intelligence in Higher Education: Enhancing, Teaching and Learning through Adaptive Technologies

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Abstract: Artificial Intelligence (AI) is moving the higher education from state to another state by using private, data-driven, and measured learning involvements. This paper discusses the combination of AI essentially usual technologies into the university level of education. It studies the function of intelligent teaching systems, virtual assistants of teaching, and adaptive programs of learning in developing the engagement of student, academic attitude, and instructive adequacy. Although the advances of AI in the higher education system are important, such as enlarged accessibility and tailored education ways, these benefits also show the ethical sides such as information secrecy, algorithmic alignment, and the changeful turn of human teachers. Depending on the recent studies, this article discusses that reliable selection of AI needs institutional aid, faculty practice, and powerful schema structures. Finally, AI has the ability to aid more universal and active educational environments when performed with impressionability, equity, and educational notion.

Keywords: AI, Higher Education, Technologies, Learning, Teaching

1. Introduction

Artificial Intelligence (AI) is swiftly moving the academic environment, presenting new options for the educational environment. In the higher education system, the technologies of artificial intelligence are used to develop the educational environments and create more efficiency systems, automated administrative systems, and developing the systems that supporting students. Artificial intelligence is becoming an essential tool for creating more efficient learning experiences and environments due to universities' increasing reliance on digital programs and educational conduct systems [1].

Developing adaptive learning technologies is one of the most important applications of artificial intelligence in the educational environment, it is known as a system that modifies the educational environment and dynamic feedback based on current student data and student performance, which in turn differs from the traditional education model that follows a uniform curriculum [2]. The adaptive learning technologies demonstrate an individualized educational approach that meets the needs of each student [3]. This is essentially very important in higher education because of the diversity of educational methods and academic objectives for students.

Following the COVID-19 pandemic, the urgent need for adaptive technologies and the acceleration of online education have become increasingly urgent. New educational

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constraints, in turn, support educational systems, their autonomy, and widespread participation [4]. These measures do not support artificial intelligence for the purpose of creating learning gaps, but rather support teachers in designing pioneering curricula and assisting them in decision-making [5]. Taking advantage of improved rates and the increased volume of student information generated by digital platforms, they instill high-quality education [6]. Furthermore, the heavy reliance on artificial intelligence, in turn, raises many questions about transparency and privacy in the future of teachers. In this paper, we explore how AI, particularly adaptive technologies, is enhancing teaching and learning in higher education. We examine its key applications, benefits, and ethical challenges, and offer recommendations for integrating AI responsibly and effectively into higher education systems.

The Role of AI in Teaching and Learning

Artificial intelligence is developing higher education through systems that support human teaching. It is also one of the most prominent systems supporting higher education and assisting in virtual teaching, which enhances the dissemination of education and the participation of more specializations in the field of artificial intelligence.

Intelligent Tutoring Systems (ITS)

Teaching and its smart systems are all AI tools that mimic human teachers by analyzing student responses and data. Furthermore, the systems can be used as natural language processors. They are also used to recognize patterns that help in assessing students and providing cognitive guidance and detailed explanations. Examples of these platforms include AutoTutor or MATHia from Carnegie Learning in challenging misconceptions and solving problems. Moreover, it was shown that teaching in smart systems is better than in traditional teaching, especially in applied subjects, science and mathematics.

Adaptive Learning Programs

Education platforms rely on the Intelligent Transportation System (ITS) by providing a broad curriculum, adjusting the learning level and difficulty through the learner performance data and control system, and creating an individual learning path and improving educational content through the use of Knew ton tools and Smart Sparrow machine learning algorithms. Teachers face difficulties in meeting the needs of students. In higher education, platforms are useful in classrooms and this helps students and teachers achieve satisfactory results.

Virtual Teaching Assistants (VTAs)

AI-powered virtual teaching assistants (VTAs) interact with students in a natural way and are often integrated into learning management systems for workshop and course discussions. They are used for assignment solving, reminders, and scheduling support. An example of such an assistant is IBM's Watson. Georgia Institute of Technology's "Gil Watson" reported that students had no idea they were interacting with an AI throughout their classes. The assistants, in turn, reduce teacher effort and provide approximately one hour of academic support per week for students, further improving educational efficiency. AI tools are demonstrating a smart transformation in the education system.

Advances of AI in Higher Education

In higher education, artificial intelligence offers a significant advantage over automation. By processing data in real-time and leveraging machine learning, AI technology improves the effectiveness of education, one of the most important areas of focus for improving specialization, decision-making, and increasing accessibility and availability.

Personalization and Learner Engagement

One of the achievements of artificial intelligence in supporting higher education on a broad personal scale. Traditional education often fails to account for individual

differences in subject matter. The AI system overcomes all obstacles by designing specific content for each student in presenting his performance and tests. Adaptive platforms such as Smart Sparrow and ALEKS adjust the complexity of the study materials and provide dynamic feedback to maintain the challenge and participation among students. Moreover, specialization increases motivation and perseverance, an example of which is the provision of intelligent systems in teaching, which enhances learners' confidence in studying complex classes. Artificial intelligence increases learner engagement and better outcomes.

2. Materials and Methods

Scalability and Access

AI technologies also address the scalability challenges faced by higher education institutions, these include large numbers of students, and intelligent systems work to provide high-quality education to large numbers of learners at the same time. This is a good evaluation of artificial intelligence in the field of online education. Artificial intelligence can immerse the heartbeats to reach education that provides support one hour per week through virtual teacher assistants. An example of this is intelligent robots that work to provide quick answers to questions, provide information and guidance beyond the geographical area and time zone. Providing capabilities and achieving justice among students, especially remote and deprived students in remote areas.

Data-Driven Decision Making

AI also empowers educators and administrators with powerful data analytics capabilities. Learning analytics systems collect and analyze student performance data to identify trends, predict outcomes, and recommend interventions. This enables faculty to make informed, evidence-based decisions about curriculum design, assessment strategies, and student support. For example, predictive analytics tools can flag at-risk students early in the semester, allowing institutions to implement timely interventions such as tutoring, counseling, or academic advising. At an institutional level, AI-driven dashboards support strategic planning by highlighting course effectiveness, enrollment patterns, and resource allocation needs. Ultimately, this data-informed approach contributes to improved retention, graduation rates, and institutional efficiency.

Challenges and Ethical Considerations

While the integration of Artificial Intelligence (AI) in higher education offers significant benefits, it also introduces complex ethical and practical challenges. These concerns must be addressed to ensure that AI-driven educational technologies are used responsibly, equitably, and transparently. Among the most pressing issues are data privacy and surveillance, algorithmic bias, and the changing nature of teacher-student relationships.

Data Privacy and Surveillance

Currently, artificial intelligence is widely used in collecting information and education, both academic and personal. Educational platforms monitor student systems and interactions, shape content, and evaluate performance. However, the level of monitoring and concerns about information security and privacy remain.

In the absence of a law for information governance, there is an imminent danger of using students' private information, or selling it to other parties or through breaches, as students are not sufficiently aware of the collection of information, which supports informed consent. Institutions are required to operate with transparency in their information practices, provide cyber security measures, and comply with regulations such as the General Data Protection Regulation (GDPR) to protect student privacy.

Bias in AI Algorithms

Artificial intelligence algorithms depend on the information used in training. Unintentionally, these algorithms do not achieve equality if they are trained on

information that differentiates between gender, race, and socio-economic status. An example of this is that the tools used to identify students at risk are indirectly divided into specific categories, regardless of the focus on individual methods. These patterns may lead to less predictable and discriminatory outputs [6]. Such practices and algorithmic transparency should be addressed to ensure equality and fairness in AI systems.

3. Results and Discussion

Impact on Teacher-Student Relationships

Increasingly automated educational practices, supported by artificial intelligence, raise questions about human education. Teaching styles and a smart, scalable and responsive system are available at the same time. Guidance and emotional support are important methods in supporting students. Teachers express their fear of relying entirely on artificial intelligence, which only marginalizes them in content management [7]. In this case, the student does not feel separated from the teacher when things are managed by algorithms instead of the teacher's participation. To preserve the relationship between teacher and student, it is likely that artificial intelligence and its tools will be designed to document the teacher's role without replacing him.

Case Studies and Current Applications

Integrating artificial intelligence into higher education from theoretical perspectives to practical applications is a path many educational institutions are taking. Current studies demonstrate how AI can enhance the quality of education, personalize practical experiences, and simplify study methods.

Georgia Institute of Technology – Jill Watson Virtual Assistant

One of the latest developments in artificial intelligence in higher education. The teaching assistant, "Jill Watson", was developed at Georgia Tech. Jill was created using IBM's Watson platform, and was employed in the training course via the Internet to answer students' inquiries [8]. Students were not sure they would be interacting with AI throughout the semester. This reduces the burden on teachers and ensures consistent answers in record time. This proves that artificial intelligence has great benefits in the field of education.

Arizona State University – Adaptive Learning with ALEKS

Arizona State University (ASU) relies on the ALEKS platform to support its mathematics curriculum. The ALEKS platform is used to assess students' learning outcomes based on their strengths and weaknesses [9]. The university documents the improvement in student scores and their contributions to the ALEKS implementation, as well as how learning platforms can be used to enhance academic achievement.

University College London – Learning Analytics and Predictive Modeling

University College London (UCL) has implemented AI-powered education data to understand student engagement and academic performance. By using the Jisc learning analytics platform, the college collects information from virtual learning environments as well as attendance records and the library. This method helps identify at-risk students [10]. Which facilitates academic matters in improving the educational reality and students' results?

Coursera and edX – Scalable AI-Powered Feedback

Massive open online courses (MOOCs), such as Coursera and edX, are being used to provide meaningful and educational experiences. Artificial intelligence is used in meals, notes, and many other important matters in education [11]. It allows teachers to focus on the content and develop it using smart, automatic systems based on artificial intelligence [12].

Duolingo – Personalized Language Learning

Duolingo is not a university institution that is a good example of AI-based learning. Machine learning algorithms are used in language teaching, rapid response and error handling [13]. Its importance and educational role in artificial intelligence lies in developing skills.

Future Prospects and Recommendations

The role of artificial intelligence in higher education is set to expand significantly in the coming years. Furthermore, the use of AI requires transparency, ethics, and the building of institutions and core objectives within the educational environment. To mitigate the risks posed by AI, teachers must be well-trained and strong governance must be in place.

Integration Strategies

Artificial intelligence is considered educational documentation, not a technological alternative. Educational institutions can work on teaching experience and consider feedback automation by using impact evaluation of evidence [14]. To ensure compatibility between artificial intelligence and its tools with student outcomes through multidisciplinary cooperation in education with technology users, taking into account feedback in designing adaptive systems and broad student participation and effectiveness in the classroom [15]. Educational institutions support smart platforms that are compatible with digital infrastructure and education.

Faculty Training and Institutional Policies

One of the things that contribute to the success of artificial intelligence is that the teacher must be prepared not only for training in the use of artificial intelligence tools, but also have a pedagogical understanding. This development must be taken into account in workshops and training courses, and the limits of bias in artificial intelligence and information literacy must be clarified [16]. Furthermore, educational institutions must set comprehensive conditions for the use and transparency of artificial intelligence. Information privacy, algorithmic ethics, and, in particular, educational integrity must be addressed. Transparency and ethical councils must be established in artificial intelligence arbitration committees, and compliance must be ensured in ensuring rights in the deployment of artificial intelligence [17].

4. Conclusion

Artificial intelligence complements traditional teaching. This study demonstrates that artificial intelligence has the potential to transform higher education, creating new and advanced paths, and in turn, supporting teachers and students with information. Moreover, these advantages stem from the responsibilities and ethics of the application challenge, which you cannot ignore. Some advanced universities explain their experience with artificial intelligence and clarify that it complements traditional teaching with comprehensive awareness and transparency in dealing with it. Institutions must strike a balance between human values and technological innovations to ensure that AI develops teachers, not replaces them, and that education is improved, not marketed. Comprehensive training and ethical oversight ensure that AI plays a significant role in building an integrated education system.

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